Journal of the Statistical and Social Inquiry Society of Ireland
Vol. XLIII

Using an Administrative Primary Care Health Activity Indicator to Address Under-enumeration in the 2011 Census in Northern Ireland

Brian Green
Jos IJpelaar
David Marshall
Robert Beatty

Northern Ireland Statistics and Research Agency

(read before the Society, 29th May 2014)

Abstract: Despite the fact that the Census Act (Northern Ireland) 1969 places a legal obligation on everyone in the Country to take part in the Census, not everyone does. This gives rise to under-enumeration, which is not unique to the Census in Northern Ireland. In Northern Ireland it is Census policy, in line with arrangements throughout the rest of the UK, that Census estimates should cover the entire population. Accordingly, Census Office is required to address any under-enumeration in the Census by imputing any details that have been missed. This paper outlines how NISRA utilised an administrative Primary Care health activity indicator to supply real demographic information (rather than modelled information) for some of the households who failed to respond to the Census. In addition, it highlights how critical design aspects of the 2011 Census were tailored in order to facilitate the approach, which has attracted considerable interest both nationally and internationally and is considered to have improved the overall quality of the 2011 Census estimates in Northern Ireland.

Keywords*:* Census, under-enumeration, sign-of-life, address, real, demographic activity, administrative, Primary Care, health, indicator, CUE, Northern Ireland, prescription, dentist, optician
JEL Classifications: J11, I10

1. INTRODUCTION

The purpose of this paper is to outline important development work that NISRA undertook in terms of utilising an administrative Primary Care health activity indicator to help address under-enumeration in the 2011 Census. The approach, which was unique to NI, is considered to have enhanced the quality of the 2011 Census estimates in Northern Ireland and has attracted considerable interest both nationally and internationally. The paper outlines both the rationale and methodology for the approach and discusses how it might be further enhanced in any future Census operation.

2. BACKGROUND

The Census is, without question, the largest statistical exercise undertaken by Government. In 2011 the Census in Northern Ireland, which was conducted on Sunday 27th March, included some 703,000 households, 1,100 Communal Establishments (such as Nursing Homes, Army Barracks, Student Halls of Residence etc) and 1.81 million people. The Census is important as it informs, amongst other things, the allocation of funds to Northern Ireland by the UK Government. In addition, it helps shape how that money is distributed throughout Northern Ireland in respect of (i) the delivery of essential services, such as education, health and transport and (ii) areas and people in greatest need. While the primary legislation that underpins the Census - the Census Act (Northern Ireland) 1969 - places a legal obligation on everyone to take part in the Census, and indeed makes provision for non-responders to be prosecuted and potentially fined up to £1,000, not everyone does. This gives rise to what is known as under-enumeration, which is not unique to the Census in Northern Ireland.

3. QUANTIFYING AND ADJUSTING FOR UNDER-ENUMERATION

In Northern Ireland it is Census policy, in line with arrangements throughout the rest of the UK, that Census estimates should cover the entire population. Accordingly, Census Office is required to address any under-

enumeration in the Census by imputing any details that have been missed. This includes details for whole households and individuals who failed to respond to the Census as well as any items that were omitted by those who did respond, but who only partially completed the questionnaire. In the 2001 Census, a Census Coverage Survey (CCS) was used post Census day to estimate the level of under enumeration. A report on the process, the One Number Census (ONC), is available at: http://www.nisra.gov.uk/archive/census/oncguide.pdf

In summary, the key steps were as follows:-

- A stratified random sample of postcodes covering some 12,000 households was completely re-enumerated by NISRA's Central Survey Unit through face-to-face voluntary interviews. The sample was stratified on the basis of whether an area was (i) urban/rural, (ii) predominantly Protestant or Catholic, and (iii) deprived/ not deprived.

- The information from these interviews was then matched against the corresponding information collected through the Census for the households in question and used to derive statistical models that provided modelled estimates for the overall number of people who had been missed, along with their key demographic details (e.g. age and sex). These statistical models, which were specific to the CCS areas, were then generalised to cover all of Northern Ireland.

- The remaining details for those households and people that were estimated to have been missed were then imputed using the characteristics of similar households and people in neighbouring areas.

In 2001, it was estimated that 95% of the population responded to the Census[1] thus 5% of the population had to be imputed. In the run up to the 2011 Census, it was recognised that getting a response from the general public was becoming increasingly more difficult due to general apathy with surveys and a level of mistrust of Government. Accordingly, there was a risk that this percentage may be higher in the 2011 Census. In order to address this, NISRA initiated its 2011 Census Under-enumeration Project, the main thrust of which was to (a) identify the address details of those households that had failed to respond to the Census, (b) explore how activity based administrative Primary Care health data might be utilised to provide evidence of 'sign-of-life' at an address, (c) capture real demographic information (e.g. age and sex) from the administrative Primary Care health information for all of the people at these addresses - not just the people with activity, and (d) impute the remaining missing information using standard Census imputation methods. Against this background, it was important to shape some critical aspects of the 2011 Census Design in order to provide a solid foundation upon which to build the approach, for example, accurately identifying all non-responding households was crucial to the methodology. These are discussed below.

4. OVERVIEW OF THE 2011 CENSUS DESIGN – THE FOUNDATION FOR THE CUE PROJECT

At the outset of the 2011 Census operation, four high level strategic aims were established. These were:-

- to provide high quality, value for money statistics that are fit for purpose and meet the needs of users;

- to maximise response rates by actively encouraging public participation in the Census and raising awareness of its important role;

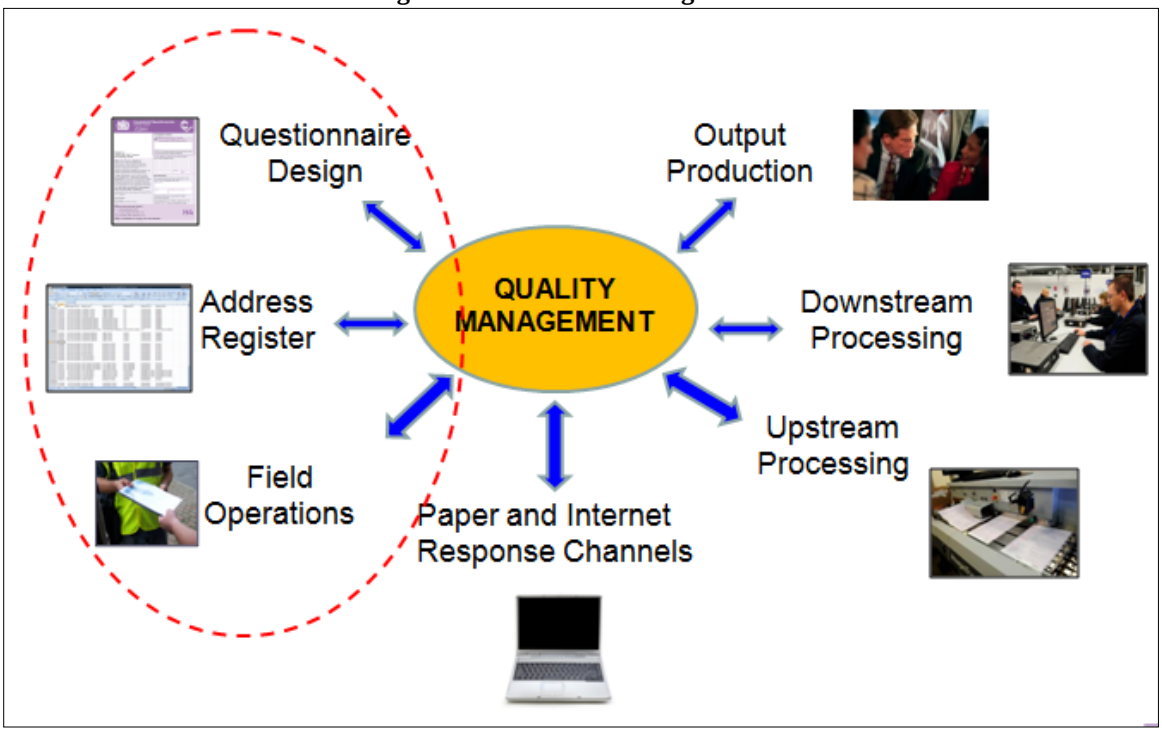
- to protect, and be seen to protect, the confidential personal information collected through the Census; and

- to secure public and user confidence in the final results and deliver them in a timely manner.

Against the background of these high level strategic aims, Quality Management considerations were central to the key components of the 2011 Census Design, which are illustrated in Figure 1 below. Three specific components of the design were pivotal to the 2011 Under-enumeration project, namely (a) the Questionnaire Design, (b) the development of the Address Register, and (c) the methodological approach to the Field Operation – these are discussed below.

[1] http://www.nisra.gov.uk/archive/census/methodologicalapproach2001.pdf

Figure 1: 2011 Census Design Initiatives

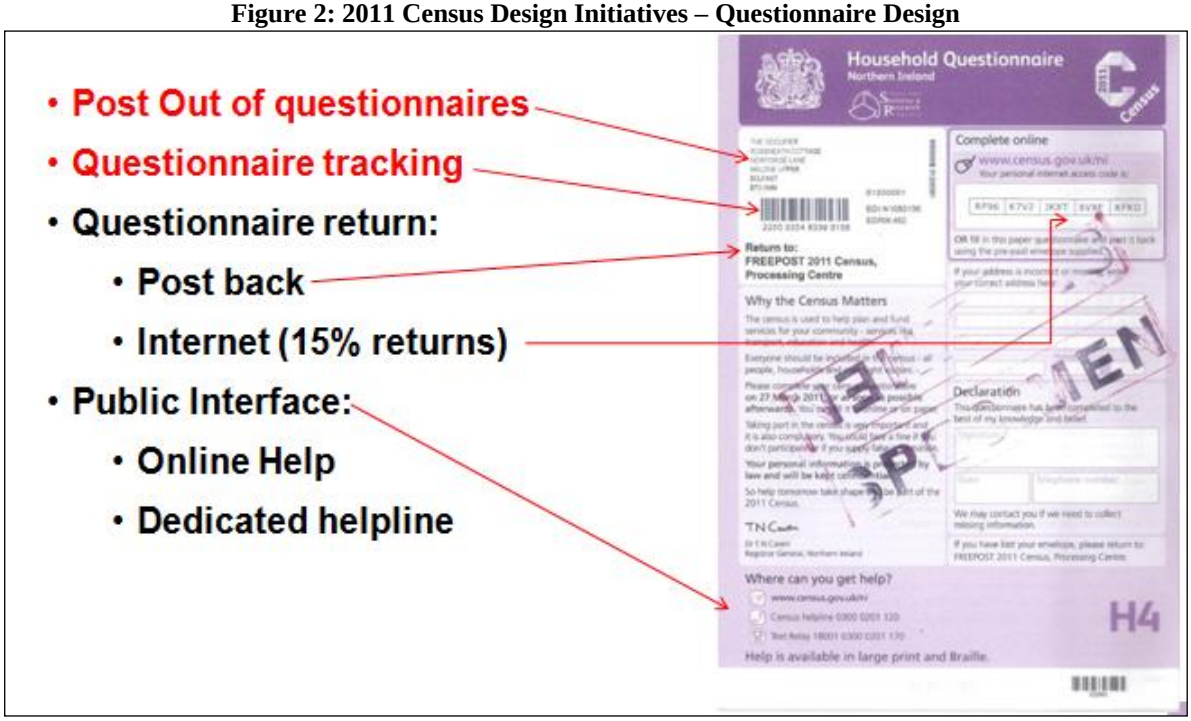


Questionnaire Design

Census Office took the decision to post out the 2011 Census questionnaires rather than have them delivered by the field staff, as was the case in 2001. All of the questionnaires were pre-addressed by Census Office in advance and passed to the Royal Mail for delivery in accordance with a pre-agreed delivery schedule. In addition, Households were, for the first time, given the opportunity to complete their Census questionnaire online and some 15 per cent of responses were returned via this channel.

In order to facilitate this, each questionnaire included an Internet Access Code (IAC), which was uniquely associated with each address. In addition, each questionnaire included a barcode, which Census Office used to track if the questionnaire had been returned. These developments had, by necessity, implications for the design of the front page of the 2011 Census questionnaire (see Figure 2 below) and were, as already stated, important in the context of the 2011 Under-enumeration Project.

Figure 2: 2011 Census Design Initiatives – Questionnaire Design



2011 Census Address Register

In order to facilitate the postal delivery of questionnaires, Census Office developed a comprehensive address register using information from the Land and Property Service's (LPS) Pointer address database. Throughout the development process, Census Office worked collaboratively with a variety of stakeholders (including LPS, Royal Mail and District Councils) and used a variety of administrative data sources (e.g. Electoral Register, Health Card Addresses) in order to be assured, in so far as it was possible, that all of the addresses included on the Census address register were both domestic and potentially occupied. For example, through its work with Royal Mail, Census Office was able to assign the Royal Mail's Unique Delivery Point Reference Number (UDPRN) to each address which, in the vast majority of cases, guaranteed successful delivery.

While addresses were, in the main, verified through extensive desk research, some 'on-the-ground' address checking was also required. Importantly, Census Office recognised that, despite these efforts, the address register would never be perfect. It was also recognised that the address register had to be finalised some six months prior to the Census in order to enable questionnaires to be over-printed with the address details and associated unique IACs and barcodes referenced above. In view of this, Census Office tailored the design of its field operation in order to (i) identify and rectify any deficiencies in the address register and (ii) identify any households that had not responded to the Census.

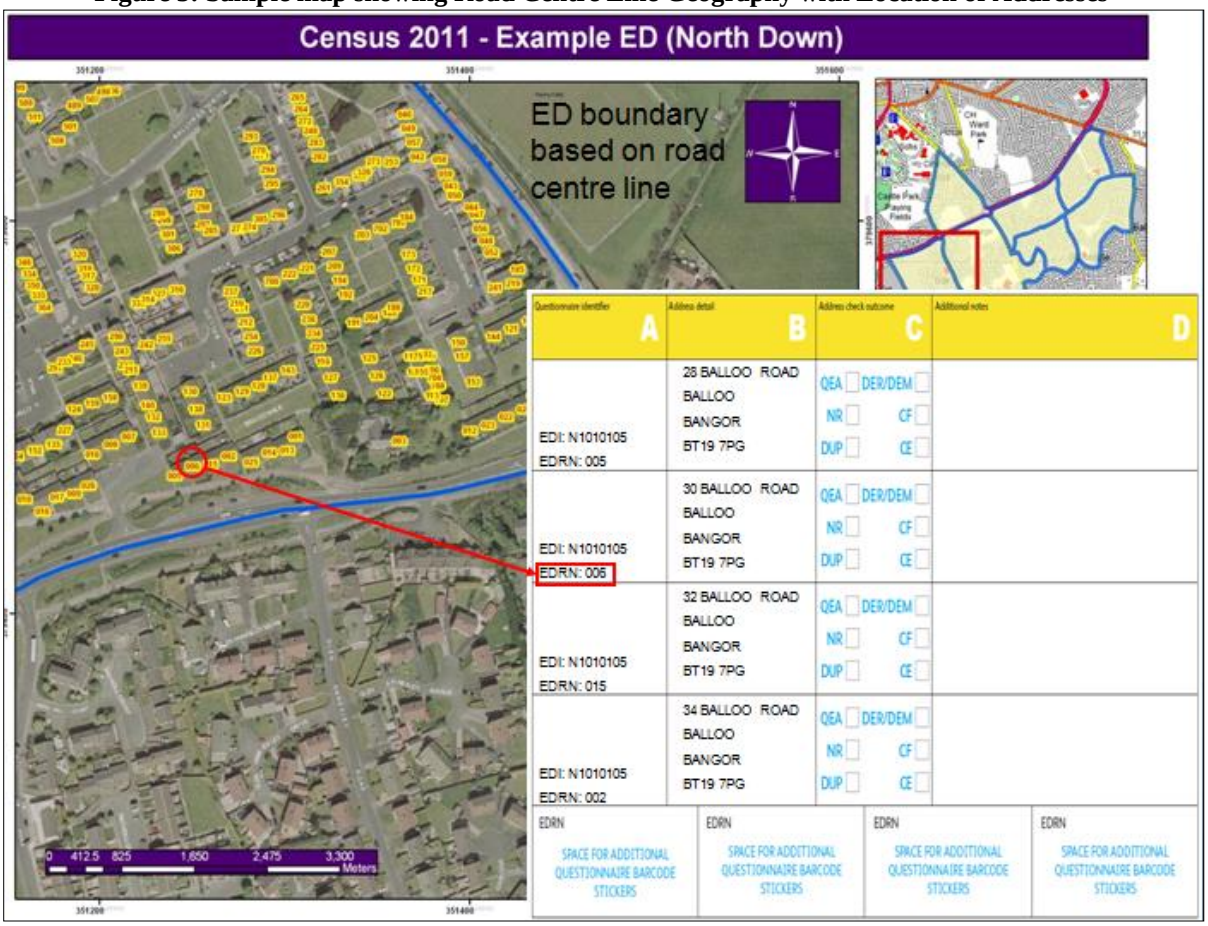
Methodological Approach to the 2011 Census Field Design

The decision to post-out the Census questionnaires in Northern Ireland, which was also implemented throughout the UK by the other Census Offices (i.e. ONS and NRS), gave rise to considerable efficiency savings and enabled Census Office to change the emphasis of the field staff roles and responsibilities. For example, in Northern Ireland, each of the 2000 temporary field staff was assigned responsibility for a fixed list of addresses and a fixed geographical area and tasked with undertaking a complete address check of the address register for their particular area. Through this, they were able to identify any addresses that had been included in error (e.g. addresses of derelict/demolished properties) and any addresses that had been inadvertently missed (e.g. new builds). In addition, the field staff were also assigned the responsibility of investigating and resolving any undelivered questionnaires. Both of these aspects, which were undertaken under much tighter levels of managerial control (i.e. a Census Team Co-ordinator in 2011 had responsibility for 6-7 enumerators as opposed to 10-14 enumerators in 2001), were critical in terms of establishing an authoritative 'truth deck' on the ground at the outset of, and during, the field operation phase.

The questionnaire tracking system that was specifically developed for 2011 used intelligence gathered through the barcode on the questionnaire to provide Census Office with near 'real-time' intelligence on those addresses that had returned a questionnaire and, by subtraction, those that were outstanding. At Census day plus 10 days, this intelligence was used to generate a follow-up list of addresses for each member of the field staff, who were required to undertake at least three follow-up visits in order to encourage and hopefully secure a return.

Importantly, from the perspective of the Census Under-enumeration project, the field staff were required at the final attempt of follow-up to provide an indication if they believed that a Census questionnaire should have been returned from an address – this was taken as evidence, at the time of the Census, of 'sign-of-life' at the address.
In order to facilitate the address checking and follow-up duties of the field staff, Census Office based the Enumeration Districts that were assigned to each member of the field staff on a road-centre-line geography. Compared with 2001, this made both the boundary and the navigation of the area considerably easier to follow. To further streamline the enumeration process, field staff were provided with a comprehensive set of maps, which pinpointed the location of the addresses that they were responsible for enumerating (See Figure 3 below).

Figure 3: Sample map showing Road Centre Line Geography with Location of Addresses



5. OVERVIEW OF THE 2011 CENSUS UNDER-ENUMERATION (CUE) PROJECT

As already outlined, the Census Under-enumeration (CUE) Project, which was piloted and refined during both the Census Test in 2007 and the Census Rehearsal in 2009, was initiated to address under-enumeration in the 2011 Census. In essence, it provided the opportunity to use an administrative Primary Care health activity indicator to supply **real** demographic information (rather than modelled CCS information) for some of the households that failed to respond to the Census.

Activities such as the collection of a prescription, changes to registration details and treatment by a NHS dentist or optician were considered to provide good evidence of 'sign-of-life' at an address (and hence residency), and helped to identify the individuals whose missing details would be captured in this manner. Importantly, if it was established through the administrative Primary Care health activity indicator that there were four people living at an address, only one of whom had some of the activities described above, the details of all four people were captured and utilised through the CUE process.

It is also important to stress at the outset that it was never the intention that the CUE process would ever replace, or negate the need for, a Census Coverage Survey. In 2011, a boosted CCS covering some 15,000 households (an increase of 25% compared with 2001) was once again used to help quantify the number of households and people who had been missed. However, this work had to be tailored to take account of the fact that some of the missing details would already have been captured using the administrative Primary Care health activity indicator prior to the information from the Census and the CCS being matched and utilised to develop statistical models as described in section 3 above. Importantly, the overall approach acknowledged that there was a risk that treating 'weaker' CUE cases (perhaps where the administrative evidence is out-of-date) as Census Day residents could result in over-enumeration. The retention of the CCS to complete the assessment of under-enumeration enabled Census Office to adopt a conservative approach in terms of regarding CUE cases as usual residences (i.e. Census Office only incorporated CUE cases where the evidence was strong).

2011 Census Requirements

The principal requirement of the CUE project was to cover a number of core information areas on occupants of properties for which a Census questionnaire had not been returned. A number of core variables, corresponding to specific questions on the Census questionnaire,[2] were to be supplied by the CUE project. These included first name and last name (Question P1), sex (P2), date of birth (P3) and Unique Property Reference Number (UPRN – corresponding to the address at the front of the Census questionnaire). The latter was subsequently used to add geographical location from the POINTER database.[3] A further seven variables were required to create a core set of characteristics to provide sufficient information for the general Census imputation algorithm to work. These included:

- relationship to Person 1 (Question H6),
- marital status (P4),
- in full-time education (P5 – yes/no),
- for students only, is this your term-time address (P6 – yes/no),
- country of birth (P7),
- intention to stay (P9), and
- address one year ago (P13).

A guiding principle for the CUE project was to provide support to the CCS and provide, where possible, **real** demographic information (rather than imputed information) for some of the households that failed to respond to the Census, while being cautious in adding households/persons to the finalised Census dataset.

6. DATA

In order to conduct the CUE project, a Data Access Agreement was set up with the Information & Registration Unit of the Business Services Organisation (BSO-IRU), to allow access to an administrative Primary Care health activity indicator (see below) of a small number of people for the purpose of the CUE project only. This agreement, enabled under Census legislation, describes in detail the secure process of transferring and handling of data.

The processes (e.g. development of address register, full address check, questionnaire tracking, field follow-up activities) described in section 4 enabled the creation of a list of addresses, along with their associated UPRN, that had failed to return a valid Census questionnaire. In September 2011, Census Office sent around 100,000 UPRNs to BSO-IRU, comprising a sample with a valid Census return and around 75,000 UPRNs for which a Census return had not been received - the list was completely anonymised in respect of whether the address was associated with a responding or non-responding household as this information was for Census purposes only.
Although the CUE process had been piloted and refined during the Census Test and Rehearsal, Census Office used the sample of records with a valid Census return to validate the CUE process prior to its implementation. For example, the information captured from the administrative Primary Care health information for the some 25,000 responding households that were included was directly compared with that captured in the Census returns in order to explore the accuracy with which the Census information could be replicated. Encouragingly, it was found that the overall number of people on the Census returns (along with their age and sex characteristics) could be replicated with a high degree of precision using the administrative Primary Care health activity indicator.

BSO-IRU supplied details of all live persons on the administrative Primary Care health information system who were resident at any of these UPRNs on Census day (27th March 2011). Information supplied for each person included:

- An anonymised unique identifier,
- Forename(s) and surname,
- Previous surname (if available),
- Gender,
- Date of birth,
- Date of registration
- Unique Property Reference Number (UPRN), and
- Month of last activity[4] in Primary Care.

Information on the month of last activity was used to quantify the likelihood that a person still resided at the address associated with the UPRN. In addition, BSO-IRU also supplied information on (a) whether a person

[2] http://www.nisra.gov.uk/archive/census/2011/forms/household.pdf
[3] http://data.gov.uk/dataset/lps-osni-pointer-download
[4] Activity included address, name or GP changes, visits to NHS dentist or optometrist, and prescriptions processed by a pharmacy. Information on the nature or exact date of the activity was not provided.

lived at the same UPRN in April 2010, (b) if a person's record was transferred from GB or was newly registered[5] in the previous 12 months, and (c) the person's country of origin for those who were newly registered since 2005. This information was to be used for the imputation of address one year ago and country of birth, as mentioned earlier.

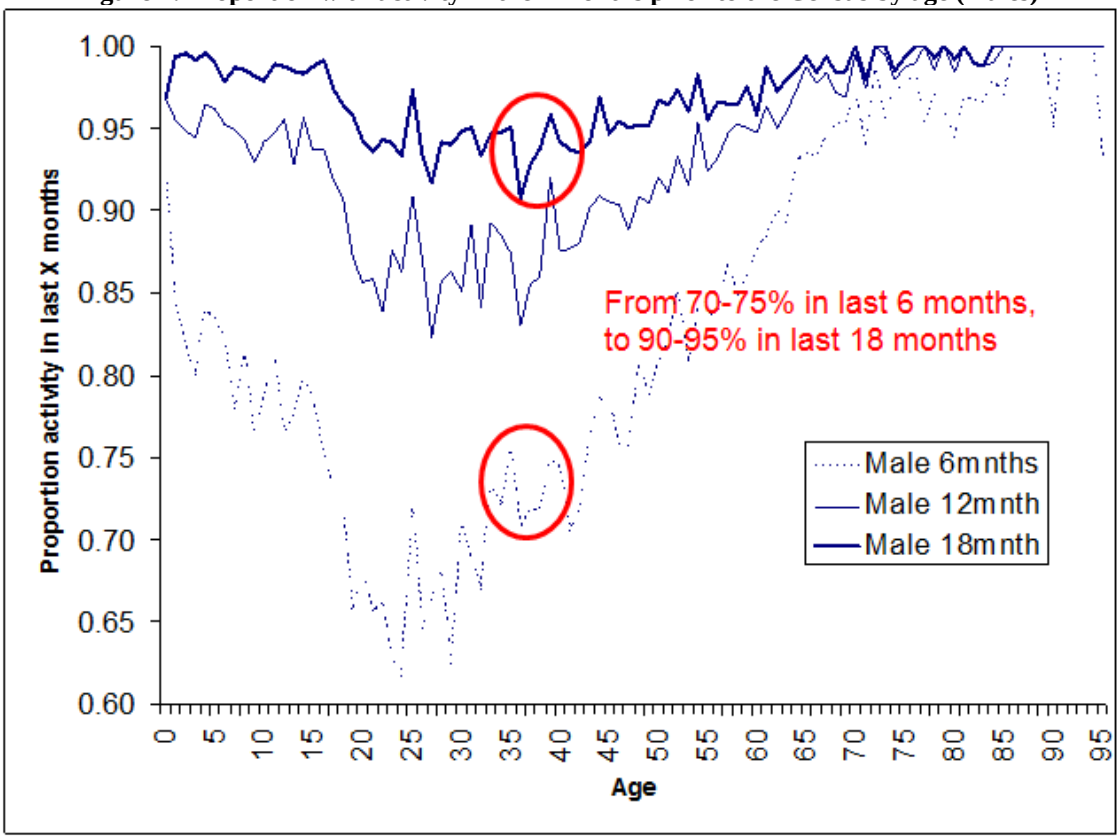
7. METHODOLOGY – HOUSEHOLDS AND PERSONS

The methodology had two components, namely, (i) selecting households and persons to be added to the final 2011 Census data file, and (ii) imputing a further seven characteristics, over and above their age and sex, for each selected person. In short, the first part of the methodology consists of placing persons at non-returning Census addresses, matched on the UPRN, followed by a quality assurance on the accuracy and consistency of the created households. It was assumed that all persons at the same property belong to a single household.[6]

The first step consisted of eliminating records which matched on name, date of birth and sex to any person on a returned Census questionnaire. There could be a delay in the reporting of an address change, so that a person could be enumerated in the Census at one address, yet their administrative Primary Care health information had them recorded at a different address. It was also possible that due to the quality of address information, different UPRNs were identified for the same address. The first step eliminated this person from CUE, as they were already enumerated elsewhere.

In the second step, only those persons who had an activity in the 18 months prior to Census day (i.e. between October 2009 and April 2011) were selected. This rule, which was considered optimal, arose from analysis carried out on the subsample of administrative Primary Care health information that could be matched to Census enumerated returns, with the cautionary principle in mind. By way of example, Figure 4 below shows how the proportion of males recorded on the administrative Primary Care health information varied by age and period of activity, clearly increasing as the period of activity was extended. Specifically, in terms of males in their thirties, it highlights that extending the period of activity from six to eighteen months increased the proportion of males who were captured from 70-75 per cent to 90-95 per cent.

Figure 4: Proportion with activity in the x months prior to the Census by age (males)



The final step was to eliminate records that made up implausible households. These include child-only households (i.e. where the eldest person is under 16 years of age), very large households (12+), and large households (6+) with multiple different surnames.

[5] Type 4 (migrant) registration.

[6] According to the 2001 Census, dwellings with multiple households only consisted of 0.005% of the total number of occupied dwellings: http://www.nisra.gov.uk/archive/census/2001/key%20statistics/district/KS16DC.xls

8. METHODOLOGY – CHARACTERISTICS

The second part of the methodology was to impute values for an additional eight variables/Census questions, as mentioned earlier. The Census imputation algorithm, which was used to deal with unanswered questions, sought to make an informed judgement based on an individual's available information, and the response to questions of comparable individuals. The method of imputation used in the CUE project aimed to mirror this process.

The available information that was utilised from the administrative Primary Care health information was restricted to a person's age and sex. This was augmented by equivalent information from other household members, as well as whether they shared the same surname. The latter helped, for example, in imputing the relationship to Person 1 and marital status. In CUE, the eldest household member was set to be Person 1. At the time of CUE, processed and validated returns of Census questionnaires included roughly 600 thousand households and 1.5 million individuals. This dataset formed the basis for comparable individuals. The imputation took the response that was most common for comparable individuals. In the simple case of a single-person household, a person's marital status was typically imputed as single when aged in their 20s or 30s, as divorced in their 40s and 50s, and as widowed at older ages. Decisions such as this were generally validated using the captured Census data.

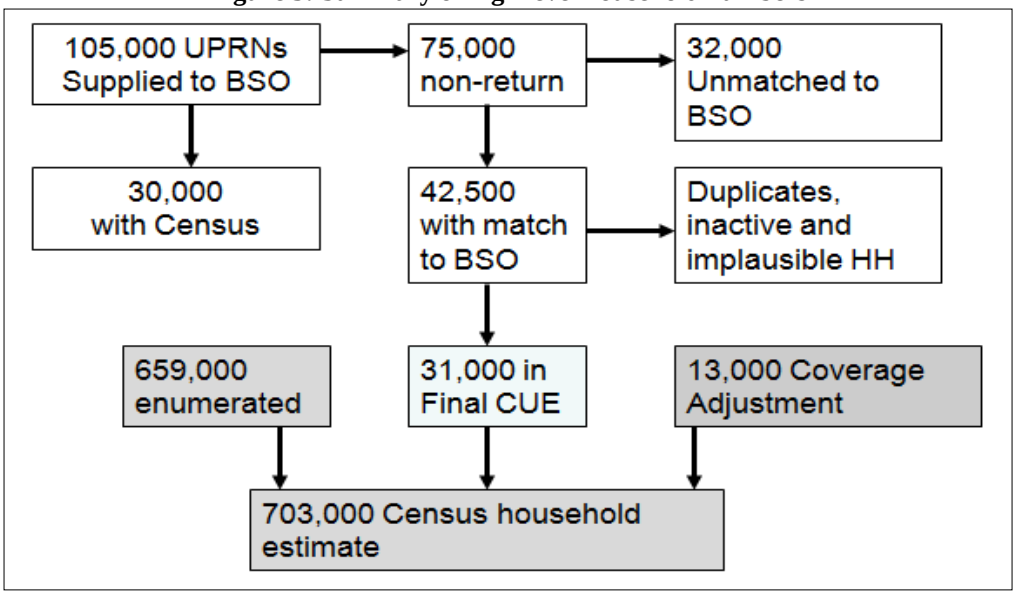
For some variables, this method did not work. In particular, when looking at country of birth, the vast majority of comparable individuals would be born in Northern Ireland and hence it would become the default for all imputations. Additional information from BSO-IRU was used to impute country of birth and address one year ago at the first instance. This was followed by matching to enumerated persons in the 2001 Census who provided information on country of birth. The final step was to look at surname only as an indicator of the country of birth.

9. RESULTS

Of the 75,000 UPRNs without a Census return, BSO-IRU could supply only details of persons registered at 42,500 of them (see Figure 5 below). Although this appears to be a large drop, the original request covered all addresses from which a return had not been received and thus included vacant properties and second homes. Further reductions to this number resulted when removing people who had responded to the Census at another address, persons without activity in the previous 18 months and implausible households. The final CUE dataset consisted of 67,700 persons at 31,000 unique addresses.

The first Census results were published in July 2012. Reference to the CUE project was made in its methodology and quality assurance reports.[7] The final estimate of 703,300 occupied households on Census day consisted of 659,200 enumerated households (94%), 31,000 households created from CUE (4%) and 13,000 households imputed based on the CCS (2%). In population terms, the percentages are slightly different at 92%, 4% and 5%, with 84,900 persons imputed based on CCS. It should be noted that while the majority of imputed persons are within wholly imputed households, some imputed persons have been inserted into enumerated or CUE households.

Figure 5: Summary of high level household numbers



[7] Paragraph 2.18 on page 9 of http://www.nisra.gov.uk/Census/pop_meth_2011.pdf#page=9, and paragraph 2.2 on page 4 of http://www.nisra.gov.uk/Census/pop_QA_2011.pdf#page=4

10. SUMMARY

The 2011 Census CUE project utilised an administrative Primary Care health activity indicator to provide evidence of 'sign-of-life' at an address and capture real (rather than modelled) key demographic information (i.e. age and sex of occupants) for some of the households that failed to respond to the Census. The approach, which was unique to Northern Ireland in the 2011 round of Censuses across the UK, was integrated into the Census Coverage Survey based coverage assessment and adjustment methodology that was applied throughout the rest of the UK and is considered to have improved the overall reliability and quality of the 2011 Census population estimates.

Importantly, where the administrative Primary Care health activity indicator suggested (for example) that four people were living at a non-responding address, only one of whom had some of the activities described above (e.g. collection of a prescription, changes to registration details and treatment by a NHS dentist or optician), the details of all four people were captured and utilised through the CUE process. In addition, while the CUE process had been piloted and refined during the 2007 Census Test and 2009 Census Rehearsal, it was also validated prior to its implementation using a sample of some 25,000 households who had returned their Census questionnaire. This demonstrated that the information captured from the administrative Primary Care health activity indicator replicated that contained in the Census returns with a high degree of precision, for example, in terms of counting the overall number of people along with their age and sex characteristics.

Looking to the future, NISRA will be exploring (through its Beyond 2011 project)[8] what additional administrative information sources might be utilised to provide 'sign-of-life' at an address and, in addition, provide actual (rather than imputed) person level attribute information (e.g. Country of Birth, Marital Status etc) for those who fail to respond to the Census. Widening the pool of available information, for example to include activity based administrative Secondary Care health information (e.g. attendance at A&E centres, admissions to hospitals) and HMRC data, would further enhance the approach by ensuring that such information was of comparable coverage and quality across all age/sex groups.

[8] http://www.ons.gov.uk/ons/about-ons/who-ons-are/programmes-and-projects/beyond-2011/index.html

VOTE OF THANKS PROPOSED BY AIDAN PUNCH, FORMERLY OF THE CENTRAL STATISTICS OFFICE

At the outset Chairman I would like to say that it gives me great pleasure to visit the Northern Ireland Statistics and Research Agency yet again – this time to propose a vote of thanks to Brian Green and Jos IJpelaar on their paper to the Society on the 2011 under-enumeration project in the Northern Ireland census.

During my time working on the Census in the South I, along with my colleagues in CSO, enjoyed close collaboration with our NISRA colleagues. This has been the case since the mid-1990s when both organisations were preparing for the then upcoming 2001 census (what was subsequently to become a 2002 census in the South because of the foot and mouth disease situation during the early part of 2001).

As NISRA operates within the broader remit of the UK statistics system I was very grateful to my UK and NI colleagues that I was able to participate as an observer in meetings of the UK census committee on a number of occasions.

We have also enjoyed collaborating with our NISRA colleagues as part of the wider International Census Forum made up of participants from Australia, Canada, Ireland, New Zealand, United Kingdom (including NI) and United States of America. The Forum has met annually and has been an invaluable means of enabling participating countries to improve their performances by attempting to emulate best practice in census taking.
In an EU context regulation 763/2008 provided the legal basis for censuses undertaken by all member states during the so-called 2010 round. This regulation focused on output harmonisation leaving individual member states free to decide how to conduct their censuses. Hence, for example the UK used post out and offered respondents the choice of internet or post back to return their completed questionnaires while we in the South stuck to the traditional personal delivery and collection of questionnaires by enumerators.

A further regulation (1201/2009) was quite strict however in terms of the topics or variables to be covered to ensure Europe wide comparability while regulation 519/2010 set out the defined programme of statistical data which each member state had to comply with. Relevant metadata also had to be provided. Finally, regulation 1151/2010 required the transmission of quality reports setting out detailed descriptions of data sources and the quality of census results. Specifically, article 3(2) of regulation 1151 requires member states to make a coverage assessment. It does not, however, explicitly require them to conduct a post enumeration survey.

I mention the EU dimension by way of background but also as a means of contextualising the work carried out by NISRA which is the subject of today's paper.

The stated objective of the Census Under-enumeration project (CUE) was to augment the coverage of the census enumeration. The CUE added a further 4 percent to the 94 percent of households enumerated while in terms of population it boosted the 92 percent coverage by a further 4 percent. The census coverage survey provided the balance. Using this yardstick the CUE would have to be deemed a success.

The use of the medical card system to boost the enumerated population puts NISRA on a sound footing in the move towards greater use of administrative data in the census process in the Beyond 2011 project. However, the success of the administrative approach to census taking will ultimately be determined by the accuracy, comprehensiveness and up-to-datedness of administrative data systems.

The procedure used for selecting households and persons to be added to the 2011 census data file appears to be prudent. For instance eliminating matches on name, date of birth and sex while only including those who had a medical card activity in the 18 months before census day are sensible measures to adopt, especially for males in their late teens and twenties where there is a trade-off between activity rates and the potential for emigration.
On the face of it, only being able to make use of 42,500 of the 75,000 unique property reference numbers might appear to be disappointing. However, as the paper points out allowance has to be made for the fact that the latter includes vacant properties and second homes.

Given that census under coverage is likely to be most prevalent among the younger more mobile population groups (especially males) and in urban areas some quantification of these aspects would have thrown greater light on the overall figures. Perhaps the relative lack of exposure of the more mobile population groups to the medical card system by comparison with other age groups (young and old) might suggest that the CUE may not be of great assistance in boosting census coverage for these categories.

Similarly given the importance of religion as a socio-demographic variable in NI it is somewhat surprising that this variable was not among those included in the core set of characteristics used to generate the census imputation algorithm. The extent to which there may or may not be differential undercount for the major religious groupings may call for these aspects to be addressed more fully. Perhaps the authors might be able to comment on this.

Turning to our own operations in the South, we have given consideration as to how beneficial a post enumeration coverage survey might be in the context of the type of enumeration we undertake and have come to the conclusion that the likely costs would outweigh the any potential benefits.

The rationale for this assessment is as follows. Enumerators are each given ownership and responsibility for their own enumeration area. In the 2011 census there were 5,000 of them. The basic register underlying the census is the national address database (the GeoDirectory) which is jointly owned by An Post and Ordnance Survey Ireland. From the 2009 census test our prior expectation was that the GeoDirectory was likely to be about 4 percent deficient. However, our experience in the field, where each enumerator was required to do a complete visual enumeration, gave rise to an additional 50,000 address points representing 2.4 per cent of the total. These additional points were indicated on the maps provided and subsequently digitised.

The emphasis in the personal delivery and collection method is on personal contact with the householder. This is demanding and exacting but pays enormous dividends in terms of being able to account for every single dwelling in each enumeration area. The enumerator is present in her EA for a ten week period (five weeks before census day and five weeks after). Strict procedures are followed where whole households are likely to be absent on census night (remember the count is de-facto). If in Ireland they have to provide the address which is then checked by the enumerator in the relevant area. If abroad they are required to sign a declaration and provide relevant travel documents etc.

A sample of each enumerators work is fully checked by their Field Supervisor to ensure that they are fully adhering to the procedures laid down. Basically each enumerator has to account for each dwelling in her area and not to take no for an answer. However, there are difficult cases and these may well persist even after escalation through the field hierarchy and in some cases visits by the local Gardaí. These amounted to approximately 7,000 occupied households representing 0.4 percent of the total in 2011. In these cases, following relevant clearance, the enumerator imputed the sex, approximate age and nationality of the relevant persons. A relatively small number of suitable cases were subsequently lined up for prosecution to illustrate that we took the matter seriously and to deter possible future non-respondents.

It is recognised that the personal delivery and collection method used is costly. It also gives rise to some negativity on the doorstep in not being able to facilitate respondents with online completion of their forms. However, the benefits are obvious. In this context it is hard to see what extra benefits a coverage survey would bring especially bearing in mind that the sampling error involved would be well in excess of the margin of undercount.

I would venture to say that as soon as we move to mixed mode such as post out, internet completion and post back then we will have no option but to back it up with a post census coverage survey as we will be unlikely to achieve the coverage achieved by the traditional method. This is unlikely to arise until 2021 however as the Government has just given the green light for Census 2016 which, because of the lateness of the final decision, will be run along the same lines as Census 2011. In fact the same questions will be asked in 2016 as were asked in 2011.

In conclusion I would like once again to thank Brian and Jos for their timely paper which focuses attention on options for the next round of censuses.

DISCUSSION

Martin Mayock:- While considering the CUE project to have been both interesting and innovative, Mr Mayock queried if consideration had been given to the feasibility of basing the imputation process on the probability profile of all potential replacement categories rather than simply using the "majority" strategy to select the most appropriate category. The presenters outlined that while such an approach was clearly meritorious and would be considered in any future work, they highlighted that the imputation outcomes (which had to be completed within very tight time constraints) were primarily informed and validated by the sample of 25,000 responding households and, accordingly, were considered to be fit for purpose.

Dr Muiris MacCarthaigh:- Dr MacCarthaigh queried if consideration had been given to drawing on other information sources that might be available from both the public and private sectors in order facilitate the Census operation and potentially further streamline the role of the field staff. He also queried if consideration had been given to using incentives in a more imaginative way in order encourage the general public to respond, particularly given the difficulties in enforcing non-compliance measures. The presenters outlined that while using the administrative Primary Care health activity indicator gave really good coverage as validated using the 25,000 records of responding households, consideration was already being given to what other information sources might provide solid evidence of 'sign-of-life' at an address in any future exercises (e.g. activity based administrative Secondary Care health information such as attendance at A&E centres, admissions to hospitals and HMRC data). In respect of incentivisation, the presenters outlined that the primary focus of the 2011 Census publicity campaign was one of stressing the importance of the Census and encouraging people to respond because of the benefits that their participation could bring to their local area. While awarding direct incentives were not implemented in Northern Ireland for the 2011 Census and would need to be considered in the context of the Census being compulsory, the presenters outlined that the relative merits of incentivisation are kept under review and experiences shared internationally. For example, rather than rewarding a household directly for completing their Census form, which they are legally obligated to do, one model could be that a donation is made to a local service (e.g. school, hospital) of the recipients choice.

Deirdre Cullen:- Deirdre Cullen offered her congratulations to NISRA for being the first to do this among the traditional census taking countries. She outlined that while Canada take income data from revenue files (with the householders permission) no other country has used administrative data to impute for missing households and, on that respect, NIRSA are now leaders in this field. The process was no doubt complicated and nuanced; the CSO would welcome a more detailed engagement with NISRA on how it was implemented in practice, examining the business flow and timelines in particular. With the introduction of postcodes in Ireland in Spring of 2015 the CSO should be in a good position to examine doing something similar, i.e. imputation of missing households using administrative files, and would certainly hope to draw on the NIRSA experience. The use of administrative data for census compilation is far from easy; it has taken many European countries up to thirty years to put systems in place for this. The new EU Regulation on Demography (EU 1260/2013) with its requirement for data on the totally usually resident population (as opposed legally registered, which is preferred by most European countries) has caused a lot of difficulties in some large European countries. There continues to be enormous benefit to holding traditional censuses and Ireland has only recently received government agreement of conducting a census in 2016.

Robert Beatty:- In response to Mr Punch's query about the importance of religion as a socio-economic variable in Northern Ireland, Robert Beatty noted that the CUE process described in the paper only went as far as the generation of a basic Census-type record. Later in the Census process, all CUE records were expanded to contain imputed values for all Census variables including religion. The imputation of the later Census variables, including religion, used the CANCEIS software developed by Statistics Canada and used widely by Census Offices across the world. Mr Beatty went on to outline how NISRA currently envisaged the CUE methodology being developed for future Censuses. NISRA planned two specific pieces of work in this area, further development of a Census Address Register, and further development of 'signs-of-life' indicators bringing together a wider range of administrative data sources, including but also beyond the current health sources. In future, the 'signs of life' indicators could pre-populate the Census Address Register, and inform where Census Office should focus their attention on encouraging compliance with the Census. A Census Coverage Survey was still considered as essential, but may have a fundamentally different design in the future. The CUE project provides a firm basis for such developments for future Censuses.

LAWS AND CONSTITUTION OF THE STATISTICAL AND SOCIAL INQUIRY SOCIETY OF IRELAND

As amended on 11 December 2008

1. The title of the Society shall be The Statistical and Social Inquiry Society of Ireland. The object of the Society shall be the promotion of the study of statistics, jurisprudence, and social and economic science.
2. The Society shall consist of Ordinary Members, Group Members and Honorary Members.
3. Applications for Ordinary and Group Membership shall be addressed to the Honorary Secretaries who shall consult with the President and then decide on the applications. The Honorary Secretaries shall subsequently inform the Council of such applications at the next meeting.
4. A Group Member may be any corporate body or unincorporated association. A Group Member shall have the privilege of nominating two representatives to attend all ordinary meetings. Each representative shall be entitled to vote.
5. The Council is empowered to recommend persons for election as Honorary members.– Persons thus recommended, may be elected by a resolution of the Society.
6. Ordinary Members shall pay a yearly subscription. This sum shall include the subscription for the Journal of the Society. The subscription becomes due on the 1st October in each year, and is payable in advance. Ordinary Members may compound for life for their annual subscription by a single specified payment. No Ordinary Member shall be entitled to any of the privileges of the Society or to vote at any meetings of the Society while his or her subscription is unpaid. No subscription shall be payable by Honorary members. A Group Member shall pay a yearly subscription and shall receive two copies of the Journal of the Society. These subscriptions shall be determined from time to time by the Council and any proposed alteration shall be ratified by a resolution passed at an Ordinary Meeting of the Society.
7. The Officers of the Society shall consist of a President, not more than eight Vice-Presidents, an Honorary Treasurer and three Honorary Secretaries who, together with fourteen other Ordinary Members of the Society shall constitute the Council.
8. Nine members of the Council, in addition to those who retire under Law 10, shall retire each year and shall be eligible for re-election without nomination. The retiring members of the Council shall be those who are most senior in membership of the council by reference to the latest date of election of each member of the Council. In the event of equal seniority, the member or members who shall retire shall be decided by agreement or, failing agreement, by lot. In the absence of a majority recommendation by the Council, no member of the council other than an officer of the Society shall be eligible for re-election on the expiration of his or her term of office or shall continue in membership of the Council if such member has not attended at least one half of the aggregate number of the meetings of the Council and of the Society which he was eligible to attend during the twelve months ending in each year on 1st April preceding the annual election of Council Members. At an ordinary meeting of the Society to be held in the month of May in each year, vacancies on the Council shall be filled by election. Notice of such election shall be given by the Honorary Secretaries to each member of the Society not less than three days before such meeting, and none but Members shall vote at such meeting. Any Member wishing to nominate a candidate for election under this Law, who has previously obtained the consent of such person, shall forward the name of the candidate to the Honorary Secretaries not later than the 20th April preceding such meeting.
9. Immediately following the election of Council members at the ordinary meeting of the Society held each year under Law 8, the Members of the Society shall elect a Member of the Council as President of the Society, and from the remaining Members of the Council they shall elect the Honorary Officers of the Society.
10. In the case of the death or resignation of an Officer or other Member of the Council, the Council may appoint a Member to supply his or her place until the next annual election. The Council shall have power at any time to co-opt a member to fill a casual vacancy on the Council, but the total number of members of the Council shall not at any time exceed the maximum number fixed under Law 7. Any member so appointed shall hold office until the next annual election and shall then be eligible for re-election.
11. The President shall preside at all meetings of the Council and of the Society, but in his or her absence the Vice-President who is the senior of those present in continuous membership of the Council shall preside. In case no Vice-President is present, the member of the Council present who is senior in membership of that body shall preside.
12. The Government of the Society and the management of its funds shall be vested in the Council, and the Honorary Treasurer shall make payments as approved by the Council.
13. The Council shall meet whenever summoned by the Honorary Secretaries of the Society on the instructions of the President, or on a requisition in writing signed by any three Members of the Council. Five members shall form a quorum, and the Chairman shall have a casting vote. Procedure at meetings of the Council shall be determined by the Council.